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RSIC CODE PACKAGE CCC-542

1. NAME AND TITLE

CAP-88:   Clean Air Act Assessment Package.

CAP-88 is an updated version of the CCC-476/CAAC package, which implemented radiological assessment methodology used for the preparation of the Environmental Protection Agency 1984 Background Information Documents on Radionuclides. See the CAP-88 web page for new developments: http://www.sc.doe.gov/sc-80/sc-83/cap88pc.shtml.

AUXILIARY ROUTINES

PREPAR2:   A user-friendly preprocessor to create AIRDOS-EPA input data sets.

AIRDOS2:   Estimates radiation doses caused by airborne radionuclides around nuclear facilities.

PREDA: Preprocessor to create DARTAB input data sets.

DARTAB2: Code for combining radionuclide environmental exposure data with dosimetric and health effects data.

RADFMT: Converts RADRISK data file to binary.

POP: Population Data Editor for PC version.

DATA LIBRARIES

ALLRAD88:   Provides element and radionuclide specific data for use by AIRDOS2.

RADRISK: Dose and risk factors for radionuclides written with RADRISK for use with DARTAB2.

2. CONTRIBUTORS

Department of Energy, Washington, DC.

EPA Office of Radiation Programs, Las Vegas, Nevada.

Brookhaven National Laboratory, Upton, New York.

3. CODING LANGUAGE AND COMPUTER

Fortran 77; IBM 3090 (C00542/I3090/00), VAX (C00542/DOVAX/00); and Fortran 77, C, and Visual Basic PC (C00542/IBMPC/01).

4.   NATURE OF PROBLEM SOLVED

The Clean Air Act Assessment Package-1988 (CAP-88) is designed for assessment of dose and risk from radionuclide emissions to air in compliance with National Emission Standards for Hazardous Air Pollutants (NESHAPs).[2] for radionuclides other than radon at DOE facilities under 40 CFR Part 61, Subpart H. CAP-88 estimates health impacts from the inhalation, ingestion, air immersion and ground surface irradiation pathways, and tabulates results for maximally exposed individuals and regional populations out to 80 kilometers. The system provides risk information in a concise, easy-to-read format and prints an echo of the input.

CAP-88 consists of updated versions of the mainframe codes AIRDOS-EPA and DARTAB. Atmospheric dispersion and deposition are calculated by AIRDOS2. Dose and risk assessment tables are calculated by DARTAB2 from the binary output file produced by AIRDOS2 and a file of dose and risk factors calculated by RADRISK. Preprocessors (PREPAR2 and PREDA) for AIRDOS2 and DARTAB2 access data bases of element and nuclide dependent data to simplify the execution of the principal programs.

5.   METHOD OF SOLUTION

AIRDOS-EPA implements a long term average Gaussian Plume model. The associated terrestrial model for deposition is based on NRC Regulatory Guide 1.109. The 50-year effective dose equivalent factors for DARTAB2 are calculated by RADRISK and use weighting factors from ICRP-26. Risks are calculated using a linear Life Table model consistent with BEIR-3. The resultant risk factors are 4.0E-4 cancer deaths per rem and 3.6E-4 cancer deaths per person working-level-month exposure to radon decay products.

CAP88-PC (Version 1.0, March 26, 1992) is able to use population data and weather data downloaded from mainframe versions of CAP88. CAP88-PC also comes with sample population arrays from some DOE facilities, and includes weather data from many DOE sites and major U.S. cities.

6.   RESTRICTIONS OR LIMITATIONS

Programs are limited to 36 radionuclides and to 20 downwind distances for each of 16 compass directions. CAP88-PC is intended for use by health physicists experienced in dose assessment. CAP88-PC is based on the Gaussian plume model with its associated limitations. The model is intended only for evaluating low-level, chronic releases; it is not appropriate for short-term accidental

releases.

7. TYPICAL RUNNING TIME

A complete run, including PREPAR2, AIRDOS2, PREDA, and DARTAB2, for an individual and population assessment requires approximately 1 and 2 minutes of CPU time, respectively, on an IBM 3090 processor. The same problem on a PC 286 (12 MHZ) took about 25 minutes.

8. COMPUTER HARDWARE REQUIREMENTS

CAP-88 is operable on the IBM mainframe computers. Memory regions for execution on an IBM 3090 system under MVS are as follows: PREPAR2, 1200 K; AIRDOS2, 900 K; PREDA, 300 K; and DARTAB2, 800 K. The Vax version was tested on a VAX 6000. The PC version requires a MS-DOS compatible personal computer with a hard disk with at least 3.5 MB of free space, 500k free RAM and a math co-processor.

9. COMPUTER SOFTWARE REQUIREMENTS

The IBM system compiled under OS/VS2 using the IBM VS compiler. The VAX version was tested using the VMS 5.4 Fortran compiler. For the PC-version Turbo C++ Version 1.0 and Lahey F77L, Version 4.10 were used to create the executable included in the package which runs under DOS 2.0 or higher. The Population Editor is written in Visual Basics and requires Windows 3.1 or higher.

10. REFERENCES

a. **Included in documentation for mainframe versions (I3090) and (DOVAX):**

B. Parks, "CAP-88: Important Differences with Earlier Version of AIRDOS-EPA," Informal notes (September 1990).

D. Beres, Editor, "The Clean Air Act Assessment Package - 1988 (CAP-88) A Dose and Risk Assessment Methodology for Radionuclide Emissions to Air", Volume 1, User's Manual, and extracted from Vol. 3 Appendix L: Available Star Data Sets, U.S. EPA (October 1990).

H. J. Bernstein, Transmittal letter and "New AIRDOS Installation -- Memo 7 & 8," (May, June 1990).

b. **Included in PC version (IBMPC):**

B. Parks, "User's Guide for CAP88-PC," 402-B-92-001 (March 1992).

Informal Notes on CAP88-PC (April 1992).

c. **Background information:**

S. J. Maheras, "CAP88-PC Population File Editor, Version 1.0," Health Phys. Society, 861, (1995).

S. J. Maheras, CAP88-PC, Health Phys. Society (July 1992).

"Risk Assessments Methodology: Environmental Impact Statement, NESHAPS for Radionuclides, Background Information Document", Vol. 1, EPA 520/1-89-005 (Sept. 1989).

C. L. Begovich, K. F. Eckerman, E. C. Schlatter, S. Y. Ohr, R. O. Chester, "DARTAB, A Program to Combine Airborne Radionuclide Environmental Exposure Data with Dosimetric and Health Effects Data to Generate Tabulations of Predicted Health Impacts," ORNL-5692 (August 1981).

R. E. Moore, C. F. Baes III, L. M. McDowell-Boyer, A. P. Watson, F. O. Hoffman, J. E. Pleasant, and C. W. Miller, "AIRDOS-EPA: A Computerized Methodology for Estimating Environmental Concentrations and Dose to Man from Airborne Releases of Radionuclides," ORNL-5532 (June 1979).

A. L. Sjoreen and C. W. Miller, :PREPAR - A User-Friendly Preprocessor to Create AIRDOS-EPA Input Data Sets, ORNL-5952 (August 1984).

11. CONTENTS OF CODE PACKAGE

Included are the referenced documents and one (1.44 MB) diskette in self-extracting compressed DOS files which contains the source codes, sample input and data libraries (C00542/I3090/00). The VAX version is transmitted on three (1.2 MB) DOS diskettes. The PC package version is transmitted on three (1.44 MB) diskettes in self-extracting compressed DOS files.

12. DATE OF ABSTRACT

February 1990, revised August 1990, September 1990, October 1990, December 1990, June 1992, August 1995.

KEYWORDS: AIRBORNE; ENVIRONMENTAL DOSE; GAUSSIAN PLUME MODEL; INTERNAL DOSE; NUCLIDE TRANSPORT; RADIOLOGICAL SAFETY; MICROCOMPUTER